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RESEARCH ARTICLE OPEN ACCESS

ARDUINO BASED SMART IRRIGATION

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ABSTRACT
This paper presents a smart irrigation system which is economical and gives the automation in the farm. The aim of this paper is to design an Arduino based controlled irrigation system using Wi-Fi module. The proposed system detects the moisture content in soil by soil moisture sensor, PH level of Soil by PH sensor and humidity using DHT11 sensor. The moisture level of soil is sensed and control according to that irrigation can be done. If the level of moisture is below the threshold level the moisture sensor sends the signal to the Arduino board and notification is send through IoT platform. As Compared with the other systems, this system gives better efficiency and it is also less expensive. Arduino collect the data from all the sensors and link that data with the cloud. The main advantage of the system is that the owner of the farm can remotely monitor their farm on IoT. The main aim of the project is to make agriculture smart using automation and IoT technology.
Keywords – Arduino Uno, ESP8266 Wi-Fi Module, LCD, Sensors.

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I. INTRODUCTION

India ranks second in the list of world's largest populated countries. The present population of India is estimated to be around 1.324 billion, which accounts for 17.74% of the world's population. India is a prime agricultural country since approximately 61% of its available land is cultivated using various crops round the clock to feed an ever-growing population. Thus, agriculture can be deemed as the backbone of the nation's economy, contributing enormously to the GDP. In order to increase the productivity per yield, there is a need to maximize the efficiency of irrigation techniques, some of which have long been practiced by traditional farmers [1].

Now a days, water scarcity and water logging has become an unpreventable issue to tackle with. Water plays an important role in the day to day life of a human being. In India lot of agricultural land and industries are already facing the drought problems, so with the help of current technology this issue can be sorted out to some extent. Today's technology requires a user-friendly device which is economical in cost and most effective as well and which is provided by Arduino board. In today's generation, it is very convenient to send the notification to IoT platform because of widespread use of smartphones and PC. In India, agriculture in villages plays an essential role in developing the country. Basically, agriculture depends on the monsoons which have not enough water sources. Most of the farmers use large portions of farming land and it becomes very difficult to reach and track each corner of large lands. Sometime there is a possibility of uneven water sprinkles [1][2]. This result in the bad quality crops which further leads to financial losses. In this scenario the Smart Irrigation System using Latest IOT Technology is helpful and leads to ease of farming. The Smart irrigation System has wide scope to automate the complete irrigation system. To overcome this problem, the irrigation system is employed in the field of agriculture. In this system, based on the soil type, the water will be provided to the agricultural field. In agriculture, there are two things, namely, the moisture content of the soil as well as the fertility of the soil [3]. At the present time, there are several types of techniques available for irrigation to reduce the need for rain. This type of technique is driven by on/off schedule using electrical power. This article discusses the implementation of a smart irrigation system using IOT.

The whole system is distributed into two parts. The first part comprises of setting up an Arduino Board and interfacing it with the sensors. The second part consists of developing the IoT platform and connecting it to the server. The ESP 8266 Wi-Fi module is used because of which the transmission becomes simpler and faster. It consists of two motors one for water pump, and second for fertilizers pump. It also helps the owner to monitor system globally throughout the world. This System

is designed to improve the security, flexibility and to remove the flaws of the existing system.

The rest of the paper is organized as follows. Section II presents a review of related literature. Section III System Architecture this Section describes the main components used in the system, and explains their operation. Section IV which also explains the operation of the system in general and the outlines results of the project. V concludes the paper

II. RELATED WORKS

The paper Sensor based Automated Irrigation System with IoT: A Technical Review [2] by Sandip Delwadkar *et al.* has discussed about controlling the flow of water through the solenoid value via the microcontroller. The microcontroller works with respect to the moist level sensor by intimating the signal to the mobile for the activation of the buzzer. These connections are established through the GSM technology. They have also proposed a methodology of controlling irrigation to the field by using geo-referenced locations with GPS technology.

Internet of Things (IoT) Based Smart Irrigation [3] by R. Hemalatha *et al.* has proposed an automatic irrigation system which checks the temperature, the humidity, the wetness and the pH level with their respective sensors connected to the Arduino Controller. From these parameters collected, stored and analyzed by the IoT system, the user discerns and remotely operates the system to pump the water to the crops

Vinoth kumar *et al.* put forward a paper on smart irrigating technique with various sensors and a microcontroller. Implementation of IoT in Smart Irrigation system using Arduino Processor [4] deals with four various sensors such as soil moisture, humidity, temperature and ultrasonic among which only the soil moisture sensor is connected to the microcontroller while the remaining three are directly connected to the Wi-Fi module. The parameters are thus collected and transmitted to the user via IoT server techno artista; thereby the user can take priest decision about irrigation.

Automatic Soil Moisture sensing Water Irrigation System with Water level Indicator [5] contributed by Edmond B. Ecjia *et al.* has been proposed to maintain stable water content in the soil. The soil moisture sensor implanted in the field detects the moisture content of the soil constantly and connect to the microcontroller. According to the soil moisture content and water level of the tank, the microcontroller predicts the obligation of the irrigation and initiates the relay switch. The Real Time Clock (RTC) is also attached to the system to irrigate the field at considerable time intervals.

The current situation of diminishing water tables, drying up of streams, rivers and tanks, eccentric environment presents a pressing require of appropriate utilization of water. To manage up with this utilization of temperature and moisture sensor at appropriate areas for observing of crops is actualized in. A calculation made with edge values of temperature and soil moistness can be adjusted into a microcontroller-based system to control water sum required for irrigation. [6]

Priyanka Padalalu et al. proposed a Smart Water Dripping System for Agriculture. The presented model control and monitor the water necessity accurately in the field. A smart irrigation system assures the sensible use of water. This design uses a microcontroller, which increases system life and curtails power consumption. This dripping water system has proposed a smart solution for the proper utilization of water, which is a massive problem in flourishing countries like India. The whole system is easy to operate by using the android system [7].

Intelligent IoT based Automated Irrigation System [8] recommended by Suresh Sankaranarayanan *et al.* deals with temperature and moisture sensors to sense the soil condition and carries to the microcontroller. A machine learning classification algorithm, K- Nearest Neighbor (KNN) has been used for the father analysis. This classification has been held in the media center Raspberry Pi3. The algorithm works accordingly with the preset training dataset and analyses the present data. The simpleton algorithm upgrades the proposed system to automatic predict the irrigation requirement.

III. SYSTEM ARCHITECTURE

3.1 System Model

In this work, an Arduino microcontroller was used to control and sense the thing such as moisture in the soil. In this purpose, a soil moisture sensor is employed to sense the moisture. The soil moisture sensor is a sensor which varies the value when it contacts the moisture. Basically it is a resistor that works on moisture condition. When the moisture is more than the value of resistance will decrease and when the moisture is less than the resistance value is more. So the sensor was calibrated into the different moisturizing condition of the water. Different values from different conditions are obtained. Different codes are generated according to the value. Put these values in the If condition of code and this If condition decides the pump will work or not. The basic block diagram of the system shown in fig.1 it consist of Arduino

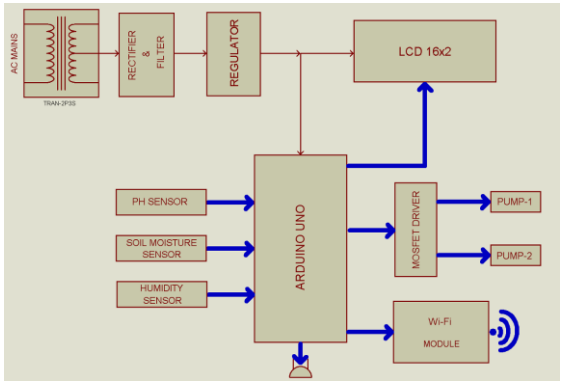

Fig.1: Block diagram of proposed system

3.2 Hardware Component

3.2.1 Power Supply

In this system motor driver required 12V power supply and soil moisture sensor, moisture sensor module required, LED indicators, sensors and ESP32 operates with DC 5V. Solar panel with battery backup circuit provides DC output and regulator to obtain regulated DC supply.

3.2.2 Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analogue inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. You can tinker with your Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. [9]The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards. The Arduino UNO is programmed using the Arduino Software (IDE).

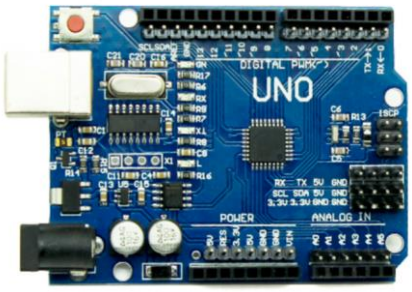

Fig.2: Arduino Uno

3.2.3 Soil moisture sensor

This sensor works on the principle of capacitor, consisting of a pair of electrodes to measure the capacitance and dielectric strength of different materials as shown in the Fig 3. In this model the material being the soil with varying amount of water content in it. The sensor builds and dielectric strength of the material together counts for the capacitance of the soil sample, depending on temperature and vapour pressure of the location. A dielectric strength

of 80 will be observed at normal room temperature which is much higher compared to our soil sample, thus, more the water content less will the capacitance detected by sensor

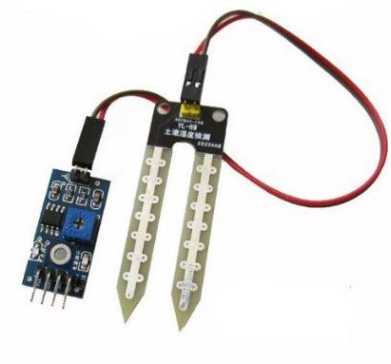

Fig.3: soil moisture sensor

It is used to sense the moisture in soil, its output is available in both format analog and digital. It has 3 pins Vcc, Gnd, Output. It has probes to sense soil moisture. It is used to measure soil moisture in land slide possibility area.

3.2.4 DHT 11

Humidity is the measure of water vapor present in the air. The level of humidity in air affects various physical, chemical and biological processes. In industrial applications, humidity can affect the business cost of the products, health and safety of the employees. So, in semiconductor industries and control system industries measurement of humidity is very important. Humidity measurement determines the amount of moisture present in the gas that can be a mixture of water vapor, nitrogen, argon or pure gas etc… Humidity sensors are of two types based on their measurement units. They are a relative humidity sensor and Absolute humidity sensor. DHT11 is a digital temperature and humidity sensor.

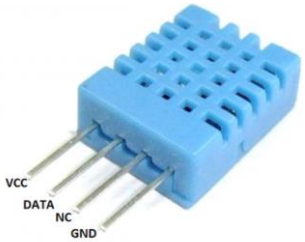

Fig.4: DHT11 Sensor

DHT11 sensor consists of a capacitive humidity sensing element and a thermistor for sensing temperature. The humidity sensing capacitor has two electrodes with a moisture holding substrate as a dielectric between them. Change in the capacitance value occurs with the change in humidity levels. The IC measure, process this changed resistance values and change them into digital form [10].

For measuring temperature this sensor uses a Negative Temperature coefficient thermistor, which causes a decrease in its resistance value with increase in temperature. To get larger resistance value even for the smallest change in temperature, this sensor is usually made up of semiconductor ceramics or polymers. DHT11 sensor has four pins- VCC, GND, Data Pin and a not connected pin shown in fig 4. A pull-up resistor of 5k to 10k ohms is provided for communication between sensor and micro-controller.

3.2.5 pH sensor

pH sensor is one of the most important tools for measuring pH and is commonly used in water quality monitoring. This type of sensor is capable of measuring alkalinity and acidity in water and other solutions. When used properly, pH sensors can ensure the safety and quality of products and processes that occur in wastewater or manufacturing plants. In most cases, the standard pH range is represented by a value in the range of 0-14. When a substance has a pH value of 7, this is considered neutral. pH values above 7 represent higher alkalinity, while substances with pH values below 7 are considered more acidic.

Fig.5: pH sensor

3.2.6: Motor driver

Microcontroller cannot drive directly current consuming sources like motor. We used MOSFET to drive motor. we used as switch IRF 540 N-channel MOSFET.

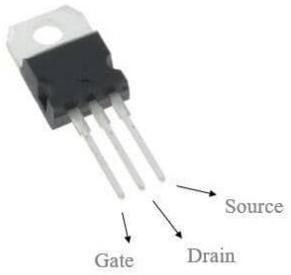

Fig.6: Motor driver

3.2.7 ESP 8266 Wi-Fi Module

The ESP8266 Wi-Fi Module is a self contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. This module comes with AT commands firmware which allows you to get functionality like arduino wifi shield, however you can load different firmware's to make your own application on the modules' memory and processor.

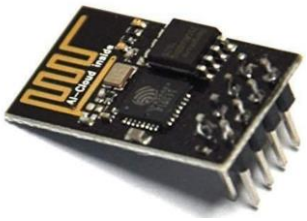

Fig.7: ESP8266 Wi-Fi Module

It's a very economic module and has a huge and growing community support. This module has onboard 80Mhz low power 32 bit processor which can be used for custom firm wares. This also means that you can host small webpages without any external controller. The ESP8266 supports APSD for VoIP applications and Bluetooth co existence interfaces; it contains a self-calibrated RF allowing it to work under all operating conditions, and requires no external RF parts.

3.2.8 Lcd Display

LCD (Liquid Crystal Display) screen is an electronic display module and find a wide range of applications. A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs.

Fig.8: Lcd Display

The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on .A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data.

3.2.9 About Thing Speak Server

Thing Speak allows you to aggregate, visualize and analyze live data streams in the cloud. Some of the key capabilities of Thing Speak include the ability to:

- Easily configure devices to send data to Things peak using popular IoT protocols.
- Visualize your sensor data in real-time.
- Aggregate data on-demand from third-party sources.
- Use the power of MATLAB to make sense of your IoT data.

- Run your IoT analytics automatically based on schedules or events.
- Prototype and build IoT systems without setting up servers or developing web software.
- Automatically act on your data and communicate using third-party services like Twilio® or Twitter®.

IV. Result

The working model of the proposed system is shown in fig.9 it detects the physical condition sensed by sensor and control the water pump and fertilizer pump.

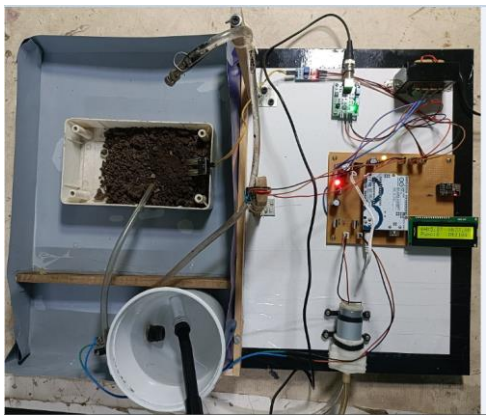

Fig.9: Proposed Working Model

In this project we have used multiple sensors like soil moisture sensor, Humidity sensor and pH sensor. As respective condition detected microcontroller takes action and shows result on LCD display.

Fig.10: Readings of sensors

Fig.11: Soil Dry Pump ON

Fig.12: Soil Wet Pump OFF

Fig.13: pH sensor and Reading on LCD

This whole system updates data on thing speak server using internet connection continuously frequency with 1 Min.

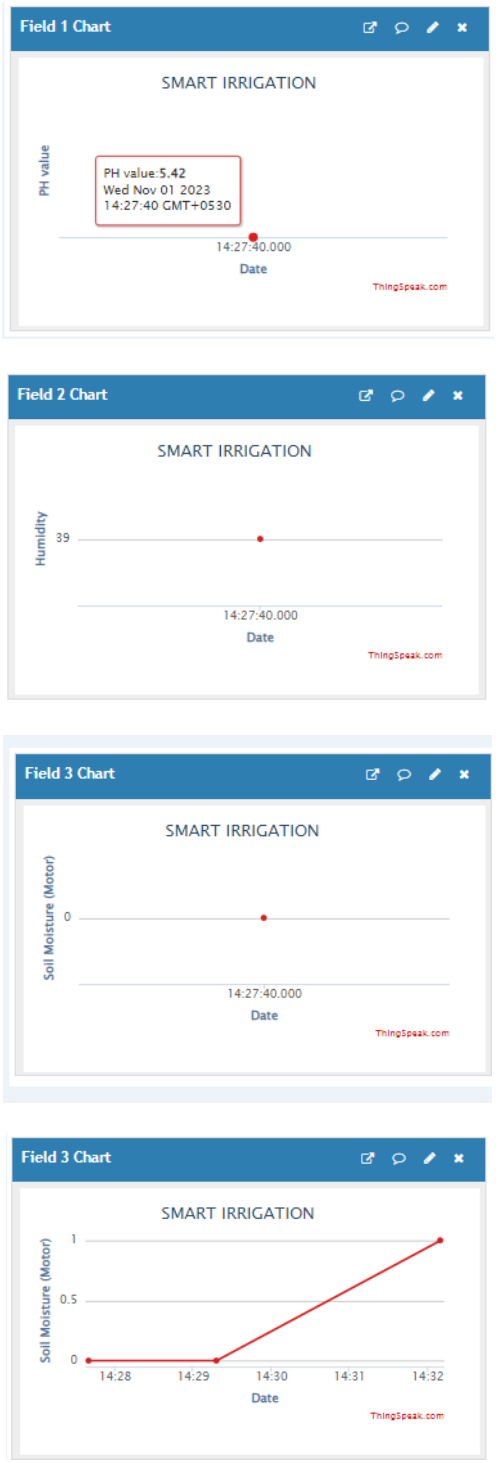

Fig .14: Output Of Sensors and Motor Condition On Things peak

V. Conclusion

In this work, we demonstrate a Smart irrigation system for remote monitoring and automatically controlled irrigation. This helps in improvement of irrigation through technology. Due to automatic control process, we can regulate the use of water and can get a better understanding of the environment of the field. It helps in increase of production rate and reduces the use of manpower and energy. Due to the cloud updates and availability of webpage user can know about the status of the field from anywhere and can control it from everywhere.

Further this proposed system can be enhanced by adding up machine learning algorithms, which are capable to study and recognize the necessities of the crop.

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